

15. Which element on the periodic table may be found in any amino acid but never in a lipid or carbohydrate?

- a. sulfur
- b. oxygen
- c. nitrogen
- d. hydrogen
- e. carbon

16. Fortifying flours and cornmeal with iron and niacin has helped to reduce the occurrence of which condition?

- a. beriberi
- b. scurvy
- c. night blindness
- d. anorexia
- e. pellagra

17. What is the monomer that makes up the polymer cellulose?

- a. glucose
- b. fructose
- c. maltose
- d. galactose
- e. glycogen

18. Which of the following flours contain the most proteins to make gluten?

- a. rice flour
- b. soy flour
- c. rye flour
- d. whole wheat flour
- e. semolina flour

19. Thiamine (Vitamin B₁) is required for the production of acetylcholine. What does the prefix “*thi*” mean in Greek?

- a. oxygen
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20. White rice is low in:

- a. lysine
- b. aspartic acid
- c. glutamic acid
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21. Using the following picture:



- a. Both muffins lack baking soda
- b. The muffin on the left has baking powder and baking soda
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- a. wheat
 - b. rice
 - c. corn
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27. Gluten naturally occurs in:
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 - b. corn
 - c. barley
 - d. rice
28. How is tofu made?
- a. Coagulating soymilk
 - b. Gelatinized soy
 - c. Partially hydrogenated soybean oil
 - d. Cheese made from goat milk
 - e. Cooked and compressed soybeans
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 - b. gelatin
 - c. fat
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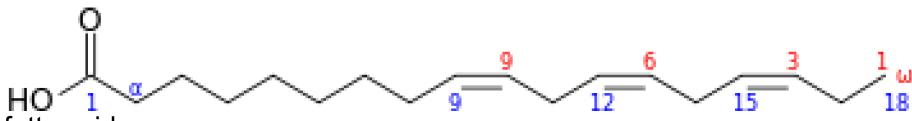
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- a. Na
- b. Mg
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- a. a non-essential fatty acid
- b. an omega-3 fat
- c. a saturated fat
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- b. Mayans
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- a. Corn
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- c. Rice
- d. All of the above

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- a. Larger kernels
- b. Corn that can withstand colder temperatures
- c. Protection from destructive caterpillars
- d. Corn to grow in drier climates

37. Most grains are:

- a. Monocotyledons
- b. Dicotyledons
- c. Angiosperms
- d. Epiphytic

38. The ancient grains spelt, einkorn, and emmer make us today's:

- a. Rice
- b. Oats
- c. Wheat
- d. Rye

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- b. hogs
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46. The picture on the right shows a disease of grains. What is the name of this common disease?

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- b. methionine and tryptophan
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- a. fructose
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- c. galactose
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- a. >20% DV
- b. >10% DV
- c. >30% DV
- d. >5% DV

52. Which contains the most calories per gram?

- a. fat
- b. protein
- c. simple carbohydrates
- d. complex carbohydrates
- e. all contain the same amount

53. Polysorbate 80 is a(n):

- a. sugar alcohol
- b. made from soybean oil
- c. made from eggs
- d. emulsifier

54. What chemical process is known to cause off flavors and odors in fatty foods?

- a. Dehydration
- b. Hydrolysis
- c. Enzymatic Browning
- d. Oxidation
- e. Decomposition

55. One symptom of celiac disease is:

- a. low blood pressure
- b. sleepiness
- c. migraine headaches
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56. In 1930 the FDA was established. This was called the:

- a. Gould Amendment
- b. Pure Food and Drug Act
- c. Delaney Clause
- d. McNary-Mapes Amendment

57. When salt is added to water the:

- a. boiling point increases and the freezing point increases
- b. boiling point decreases and the freezing point decreases
- c. the boiling point increases and the freezing point decreases
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58. Triticale has more protein than any wheat and is a cross between wheat and ____.

- a. barley
- b. rye
- c. oats
- d. corn

59. Which is a true statement?

- a. white rice has the outer hull only
- b. brown rice has the outer hull and bran layer removed, but has a cereal layer
- c. white rice has the outer hull plus the bran layer and cereal germ removed
- d. brown rice has all the layers intact

60. The color pigment in flour, anthoxanthin is whiter when the batter for angel food is:

- a. acidic
- b. basic
- c. neutral

61. Ammonium bicarbonate is a leavening agent only used in making:
- a. cakes
 - b. pizza
 - c. bread
 - d. crackers
62. Which of the following grains is low in calories, helps with type 2 diabetes, helps lower heart disease and may help prevent cancer?
- a. Millet
 - b. Buckwheat
 - c. Wheat berries
 - d. Spelt
63. Nitrite prevents the growth of:
- a. *botulinum*
 - b. *perfringens*
 - c. *S. aureus*
 - d. yeasts
64. Nixtamalization is the process by which:
- a. quinoa is made
 - b. hominy grits are made
 - c. polenta is ground
 - d. the stalk is removed from wheat
65. Which of the following grains is grown on more land of acres than any other crop in the world?
- a. wheat
 - b. corn
 - c. oats
 - d. barley
66. Which of the following contains all of the 8 essential amino acids?
- a. whole wheat bread and peanut butter
 - b. hummus
 - c. refried beans and corn tortillas
 - d. all of the above

Using the Nutrition Facts below to calculate answers for questions 67-70.

67. Given that 1 Calorie is equal to 4.18 KJ, how many KJ are in one box of this cereal?
68. How many mg of Potassium are in each gram of the cereal?
69. What is the percent of total carbohydrates per gram for one serving of this cereal?
70. What is technically wrong with the label ‘Potassium’ on the Nutrition Facts label?

Nutrition Facts	
8 servings per container	
Serving size	2/3 cup (55g)
<hr/>	
Amount per serving	
Calories	230
<hr/>	
	% Daily Value*
Total Fat 8g	10%
Saturated Fat 1g	5%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 160mg	7%
Total Carbohydrate 37g	13%
Dietary Fiber 4g	14%
Total Sugars 12g	
Includes 10g Added Sugars	20%
Protein 3g	
<hr/>	
Vitamin D 2mcg	10%
Calcium 260mg	20%
Iron 8mg	45%
Potassium 235mg	6%
<hr/>	
* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.	

STOP!!: You and your partner MUST wear goggles and aprons at ALL times while doing Part 2 and Part 3.



Part 2

A new processing plant opened with a complete line of nutritional drinks, juices and flavored waters. You are the quality control manager at the plant, and get a frantic phone call one afternoon. Someone has made a big mistake, putting all the drink mixes into unlabeled containers! (15 points)

The products are:

Muscle Pro	contains glucose, protein
H ₂ O Wow!	contains protein, starch
Electro-H ₂ O	contains electrolytes
Sweet- H ₂ O	contains glucose

Your job at this station is to figure out how to label the drinks correctly. You have at your disposal four containers of the above-unknown drinks: A, B, C, and D plus all the needed equipment and your kit. The reagents are available to you and any other equipment you might need.

Answers must be places on the answer sheet provided.

You must wear protective eyewear and aprons. DO NOT TASTE ANY SAMPLES or you will be given a zero on this part and a penalty of negative 25 points.

ANSWERS ARE: A, B, C OR D on the answer sheet

71. Which unknown is the H₂O Wow? (4 points)
72. Which unknown is the Muscle Pro? (4 points)
73. Which unknown is the Electro-H₂O? (3 points)

74. Which unknown is the Sweet-H₂O? (4 points)



FOOD SCIENCE TEST
NATIONAL 2017
ANSWER SHEET

School Name Printed: _____

Team number: _____

Participants' names:

Print: _____

Print: _____

Participants' names:

Signature: _____

Signature: _____

JUDGE ONLY:

Part	Points
Part 1	/70pts
Part 2 Lab	/15pts
Part 3 Calorimeter	/15pts
Total	/100pts
Tie Beaker	

Place	
-------	--

TEAM # _____

- | | | |
|-----------|-----------|-----------|
| 1. _____ | 31. _____ | 60. _____ |
| 2. _____ | 32. _____ | 61. _____ |
| 3. _____ | 33. _____ | 62. _____ |
| 4. _____ | 34. _____ | 63. _____ |
| 5. _____ | 35. _____ | 64. _____ |
| 6. _____ | 36. _____ | 65. _____ |
| 7. _____ | 37. _____ | 66. _____ |
| 8. _____ | 38. _____ | 67. _____ |
| 9. _____ | 39. _____ | 68. _____ |
| 10. _____ | 40. _____ | 69. _____ |
| 11. _____ | 41. _____ | 70. _____ |
| 12. _____ | 42. _____ | |
| 13. _____ | 43. _____ | |
| 14. _____ | 44. _____ | |
| 15. _____ | 45. _____ | |
| 16. _____ | 46. _____ | 71. _____ |
| 17. _____ | 47. _____ | 72. _____ |
| 18. _____ | 48. _____ | 73. _____ |
| 19. _____ | 49. _____ | 74. _____ |
| 20. _____ | 50. _____ | |
| 21. _____ | 51. _____ | |
| 22. _____ | 52. _____ | |
| 23. _____ | 53. _____ | |
| 24. _____ | 54. _____ | |
| 25. _____ | 55. _____ | |
| 26. _____ | 56. _____ | |
| 27. _____ | 57. _____ | |
| 28. _____ | 58. _____ | |
| 29. _____ | 59. _____ | |
| 30. _____ | | |

Part 2

Part 3

75. Calorimeter testing: (15 Points)

Using your calorimeter and the water provided, find the number of joules/gram of your food item by burning the foodstuff. **Be sure to CLEAN UP** when you are done or penalty points will be assessed (negative 10 points). Place all of your data, calculations and formulas on the answer sheet provided. The final answer should be in scientific notation. Specific Heat of water is: $4.18\text{J/g}\cdot^{\circ}\text{C}$ (15 points)

Data	
Formulas used	
Math	
Answer (j/g)	

Directions for using Benedict's Solution:

1. Place 1mL of your unknown in a test tube using the graduated cylinder provided.
2. Place 5-7 drops of Benedict's Solution in the same test tube.
3. Heat the test tube in water bath.
4. Observe after 2 minutes any change in color.
5. Remove the hot test tube from the water with the test tube holder provided.

Directions for using Biuret's Solution:

1. Place 1mL of your unknown in a test tube using the graduated cylinder provided.
2. Place and 10-12 drops of Biuret Solution in the same test tube.
3. Observe after 3 minutes for any change

Directions for using Lugol's Iodine Solution:

1. Place 1mL of your unknown in a test tube using the graduated cylinder provided.
2. Place 1-2 drops of Iodine Solution in the same test tube.
3. Observe any change in color.

Supervisor Directions:

- 1. Set up at the station with your Team number on the test answer sheet.**
- 2. Place team number on all answer sheets.**
- 3. You must clean up at the end or there will be a 10 point penalty.**
- 4. The directions for use of the reagents is in plastic taped down by your station.**
- 5. There is a waste cup for you to use for all your waste.**
- 6. You may do parts 2 or 3 at any time, but both of you must wear goggles during testing.**
- 7. Please write legibly.**
- 8. You have 50 min for the event.**
- 9. Someone will be around to measure your calorimeter and check your notes for 5 pages.**
- 10. If you need more of the samples, please raise your hand.**
- 11. Balances are located _____**
- 12. Please step away to clean your goggles.**
- 13. Stapler for your test is here.**

For Judge ONLY

Team # = _____

Calorimeter in specs	/2 points
Initial and final Temp makes sense	/2 points
Mass of food makes sense	/1 point
Mass of water makes sense	/1 point
Formula used is correct and numbers correctly substituted for Energy gained by water	/2 points
Calorimeter constant ID'ed	/2 points
Formula for final j/g of food correctly done	/2 points
Answer within 11-20% =1 pts 0-10% =2 pts	/2 points
Answer sig fig and Scientific Notation	/1 point
Total points	/15 points



Exploring the World of Science

FOOD SCIENCE
National Test
DIVISION B 2017



WRIGHT STATE *UNIVERSITY*

DIRECTIONS:

1. Do **NOT** open this test until told to do so.
2. Place all of your answers on the answer sheets. You and your partner may do the lab and test your Calorimeter whenever you want. Answers are to be put on the answer sheet for all parts of the test.

Part 1 is: Questions #1-70 are Multiple Choice and short answer. These questions must be answered on the answer sheet = 1 point each

Part 2 is: Lab Tasks Questions #71-74 = 15 points

Part 3 is: Calorimeter as Question 75 = 15 points

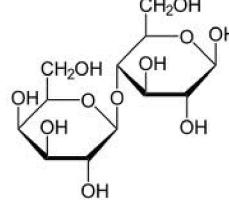
Directions: Select the best response. Unless designated, there is only one correct answer. (1 point each)

1. What two monomers make up high fructose corn syrup?
 - a. glucose and glucose
 - b. glucose and galactose
 - c. galactose and galactose
 - d. **fructose and glucose**
 - e. fructose and galactose

2. What functional group reacts with a sugar and Benedict's solution to produce the orange colored precipitate?
 - a. ketone
 - b. organic acid
 - c. **aldehyde**
 - d. ether

3. What was the first use for cornstarch?
 - a. **laundry**
 - b. thickener
 - c. drying agent
 - d. anti-caking agent
 - e. baby powder

4. Baking powder contains monocalcium phosphate, MCP and sodium aluminum sulfate, SAS. Which of the following is true?
 - a. SAS is soluble at room temperature
 - b. SAS releases gas when baking powder is mixed initially with the dough.
 - c. **SAS releases gas when the dough is baked.**
 - d. MCP releases gas bubbles when dough is baked.

5. What is the name of this molecule?
 - a. fructose
 - b. glucose
 - c. **lactose**
 - d. galactose
 - e. sucrose

6. How many different amino acids are there?
 - a. 4
 - b. 10
 - c. **20**
 - d. 23
 - e. 64

7. What ingredient is known to give beer its characteristic flavor and odor during fermentation?

- a. Mead
- b. Malt
- c. Hops
- d. Barley
- e. Mash

8. Which of the following is a water-soluble vitamin?

- a. Vitamin A
- b. Vitamin C
- c. Vitamin D
- d. Vitamin E
- e. Vitamin K

9. Which of the following oils has the least number of saturated bonds?

- a. olive oil
- b. corn oil
- c. canola oil
- d. peanut oil
- e. coconut oil

10. Which of the following is a false statement about oils?

- a. oils add flavor
- b. help prevent burning of food and are not harmful if they are burned
- c. provide an energy source.
- d. provide healthy fats like DHA
- e. oils provide cancer-fighting CLA

11. Which vitamin is hydrophilic?

- a. B₁₂
- b. A
- c. E
- d. D
- e. K

12. This is a picture of a positive test for:

- a. fats
- b. glucose
- c. proteins
- d. organic acids



13. What do grass fed cows have more of?
- omega 6 fats
 - ω-3 fatty acids**
 - oleic acid
 - nervonic acid
14. The Maillard reaction refers to a complex set of reactions between amines and carbonyl compounds. The reaction is a form of non-enzymatic browning between a protein and a reducing sugar. The browning is caused by an insoluble brown product called:
- melanoidin**
 - actomyosin
 - caffeine
 - gingerols
 - glycoproteins
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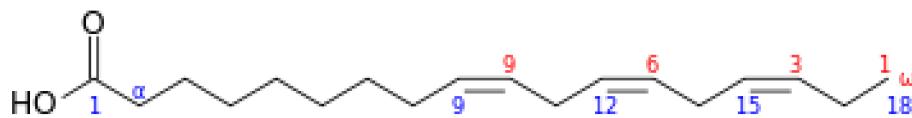
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 - b. brown rice has the outer hull and bran layer removed, but has a cereal layer
 - c. **white rice has the outer hull plus the bran layer and cereal germ removed**

- d. brown rice has all the layers intact
60. The color pigment in flour, anthoxanthin is whiter when the batter for angel food is:
a. acidic
b. basic
c. neutral
61. Ammonium bicarbonate is a leavening agent only used in making:
a. cakes
b. pizza
c. bread
d. crackers
62. Which of the following grains is low in calories, helps with type 2 diabetes, helps lower heart disease and may help prevent cancer?
a. Millet
b. Buckwheat
c. Wheat berries
d. Spelt
63. Nitrite prevents the growth of:
a. *botulinum*
b. *perfringens*
c. *S. aureus*
d. yeasts
64. Nixtamalization is the process by which:
a. quinoa is made
b. hominy grits are made
c. polenta is ground
d. the stalk is removed from wheat
65. Which of the following grains is grown on more land of acres than any other crop in the world?
a. wheat
b. corn
c. oats
d. barley
66. Which of the following contains all of the 8 essential amino acids?
a. whole wheat bread and peanut butter
b. hummus
c. refried beans and corn tortillas
d. all of the above

Using the Nutrition Facts below to calculate answers for questions 67-70.

67. Given that 1 Calorie is equal to 4.18 KJ, how many KJ are in one box of this cereal?
68. How many mg of Potassium are in each gram of the cereal?
69. What is the percent of total carbohydrates per gram for one serving of this cereal?
70. What is technically wrong with the label 'Potassium' on the Nutrition Facts label?

Nutrition Facts	
8 servings per container	
Serving size	2/3 cup (55g)
<hr/>	
Amount per serving	
Calories	230
<hr/>	
% Daily Value*	
Total Fat 8g	10%
Saturated Fat 1g	5%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 160mg	7%
Total Carbohydrate 37g	13%
Dietary Fiber 4g	14%
Total Sugars 12g	
Includes 10g Added Sugars	20%
Protein 3g	
<hr/>	
Vitamin D 2mcg	10%
Calcium 260mg	20%
Iron 8mg	45%
Potassium 235mg	6%
<hr/>	
* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.	

STOP!!: You and your partner MUST wear goggles and aprons at ALL times while doing Part 2 and Part 3.



Part 2

A new processing plant opened with a complete line of nutritional drinks, juices and flavored waters. You are the quality control manager at the plant, and get a frantic phone call one afternoon. Someone has made a big mistake, putting all the drink mixes into unlabeled containers! (15 points)

The products are:

Muscle Pro	contains glucose, protein
H ₂ O Wow!	contains protein, starch
Electro-H ₂ O	contains electrolytes
Sweet- H ₂ O	contains glucose

Your job at this station is to figure out how to label the drinks correctly. You have at your disposal four containers of the above-unknown drinks: A, B, C, and D plus all the needed equipment and your kit. The reagents are available to you and any other equipment you might need.

Answers must be places on the answer sheet provided.

You must wear protective eyewear and aprons. DO NOT TASTE ANY SAMPLES or you will be given a zero on this part and a penalty of negative 25 points.

ANSWERS ARE: A, B, C OR D on the answer sheet

71. Which unknown is the H₂O Wow!? (4 points)
72. Which unknown is the Muscle Pro? (4 points)
73. Which unknown is the Electro-H₂O? (3 points)
74. Which unknown is the Sweet-H₂O? (4 points)



FOOD SCIENCE TEST
NATIONAL 2017
ANSWER SHEET

School Name Printed: _____

Team number: _____

Participants' names:

Print: _____

Print: _____

Participants' names:

Signature: _____

Signature: _____

JUDGE ONLY:

Part	Points
Part 1	/70pts
Part 2 Lab	/15pts

Part 3 Calorimeter	/15pts
Total	/100pts
Tie Beaker	
Place	

TEAM #

- | | | |
|--------------|--------------|------------------------------------|
| 1. <u>d</u> | 26. <u>b</u> | 50. <u>a</u> |
| 2. <u>c</u> | 27. <u>c</u> | 51. <u>a</u> |
| 3. <u>a</u> | 28. <u>a</u> | 52. <u>a</u> |
| 4. <u>c</u> | 29. <u>a</u> | 53. <u>d</u> |
| 5. <u>c</u> | 30. <u>b</u> | 54. <u>d</u> |
| 6. <u>c</u> | 31. <u>c</u> | 55. <u>d</u> |
| 7. <u>c</u> | 32. <u>b</u> | 56. <u>d</u> |
| 8. <u>b</u> | | 57. <u>c</u> |
| 9. <u>c</u> | 33. <u>a</u> | 58. <u>b</u> |
| 10. <u>b</u> | 34. <u>b</u> | 59. <u>c</u> |
| 11. <u>a</u> | 35. <u>d</u> | 60. <u>a</u> |
| 12. <u>c</u> | 36. <u>c</u> | 61. <u>d</u> |
| 13. <u>b</u> | 37. <u>a</u> | 62. <u>a</u> |
| 14. <u>a</u> | 38. <u>c</u> | 63. <u>a</u> |
| 15. <u>c</u> | 39. <u>a</u> | 64. <u>b</u> |
| 16. <u>e</u> | 40. <u>c</u> | |
| 17. <u>a</u> | 41. <u>a</u> | 65. <u>a</u> |
| 18. <u>e</u> | 42. <u>d</u> | 66. <u>d</u> |
| 19. <u>c</u> | 43. <u>c</u> | 67. <u>7,691.2 KJ</u> |
| 20. <u>a</u> | 44. <u>a</u> | 68. <u>427 mg/g</u> |
| 21. <u>c</u> | 45. <u>d</u> | 69. <u>67%</u> |
| 22. <u>a</u> | 46. <u>a</u> | 70. <u>should be K⁺</u> |
| 23. <u>b</u> | 47. <u>b</u> | |
| 24. <u>a</u> | 48. <u>b</u> | |
| 25. <u>a</u> | 49. <u>c</u> | |

Part 2

71. B

72. D

73. A

74. C

Part 3

75. Calorimeter testing: (15 Points)

Using your calorimeter and the water provided, find the number of **joules/gram** of your food item by burning the foodstuff. **Be sure to CLEAN UP** when you are done or penalty points will be assessed (negative 10 points). Place all of your data, calculations and formulas on the answer sheet provided. The final answer should be in scientific notation. Specific Heat of water is: 4.18j/g·°C (15 points)

Data	Water Initial Water Final Mass of water used	Mass of substance Initial Mass of substance final
Formulas used	$Q = m \times c \times \Delta T$ Calorimeter Constant Mass used = Mass of substance initial – final	

Math	<p>Show that substituted for: $Q = m \times c \times \Delta T$</p> <p>Add above and Cal Const.</p> <p>Q final/mass of substance</p>
Answer (j/g)	<p>16,720 j/g → 20,900 j/g → 25,080 j/g</p>

Directions for using Benedict's Solution:

1. Place 1mL of your unknown in a test tube using the graduated cylinder provided.
2. Place 5-7 drops of Benedict's Solution in the same test tube.
3. Heat the test tube in water bath.
4. Observe after 2 minutes any change in color.
5. Remove the hot test tube from the water with the test tube holder provided.

Directions for using Biuret's Solution:

1. Place 1mL of your unknown in a test tube using the graduated cylinder provided.
2. Place 3-5 drops of Biuret Solution in the same test tube.
3. Observe after 3 minutes for any change

Directions for using Lugol's Iodine Solution:

1. Place 1mL of your unknown in a test tube using the graduated cylinder provided.
2. Place 1-2 drops of Iodine Solution in the same test tube.
3. Observe any change in color.

Supervisor Directions:

1. Set up at the station with your Team number on the test answer sheet.
2. Place team number on all answer sheets.
3. You must clean up at the end or there will be a 10 point penalty.
4. The directions for use of the reagents is in plastic taped down by your station.
5. There is a waste cup for you to use for all your waste.
6. You may do parts 2 or 3 at any time, but both of you must wear goggles during testing.
7. Please write legibly.
8. You have 50 min for the event.
9. Someone will be around to measure your calorimeter and check your notes for 5 pages.
10. If you need more of the samples, please raise your hand.
11. Balances are located _____
12. Please step away to clean your goggles.
13. Stapler for your test is here.

For Judge ONLY

Team # = _____

Calorimeter in specs	/2 points
Initial and final Temp makes sense	/2 points
Mass of food makes sense	/1 point
Mass of water makes sense	/1 point
Formula used is correct and numbers correctly substituted for Energy gained by water	/2 points
Calorimeter constant ID'ed	/2 points
Formula for final j/g of food correctly done	/2 points

Answer within 11-20% =1 pts 0-10% =2 pts	/2 points
Answer sig fig and Scientific Notation	/1 point
Total points	/15 points

Team Name: _____

Team Number: _____

Student Names: _____ & _____

Time Started: _____ Time to Finish (50 Min Max): _____



Directions: You will be given 50 minutes to complete the following written test on topics described in the official rules of the Hovercraft event. Please write legibly as answers that cannot be interpreted will not receive credit. The blank spaces on the paper may be used to do calculations and work (as well as blank paper provided), but ***credit will only be given for the answer provided in the box on the left side of the question.***

Be sure to put your team number on every page. You **are** allowed to separate the test and each team member may work independently, but please staple the test in the correct order before turning it in.

The following question numbers align with the four categories in the rules:

Questions 1-7: Newton's Laws of Motion: inertia, force, impulse, action-reaction

Questions 8-14: Kinematics: projectile velocity, speed, acceleration, position

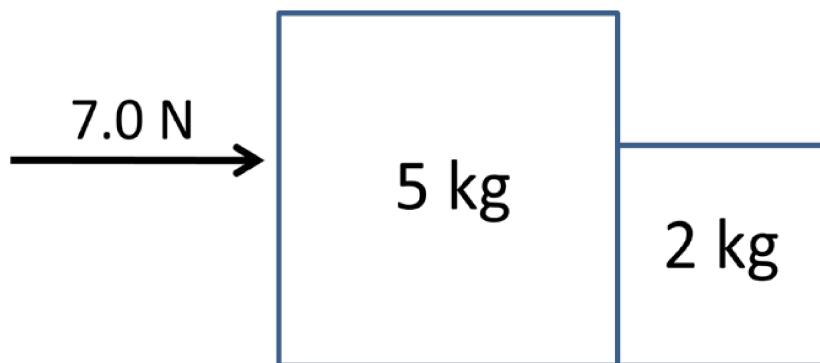
Questions 15-21: Kinetic energy: calculation, momentum, non-relativistic

Questions 22-28: Air cushioned vehicles and applications: history, design, capabilities

Good Luck and Enjoy the Experience!

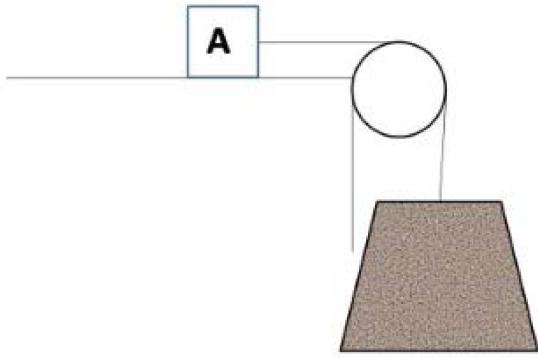
	<p>1. Which of Newton's three laws states that the rate of change of momentum of a body is directly proportional to the force applied and this change in momentum takes place in the same direction as the direction of the applied force?</p>
	<p>2. What is the acceleration of an object of mass 15 kg that is pushed with a net force of 150 N?</p>

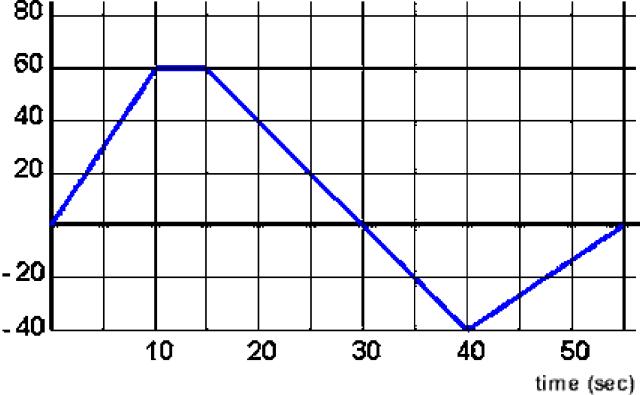
Use the picture below to answer questions 3 and 4:



3. Two masses of 5.0 kg and 2.0 kg are in contact with each other on a smooth, frictionless surface. A force of 7.0 N acts on the 5.0 kg mass in the positive x-direction. Calculate the magnitude of the action-reaction force pair at the interface between the two masses in Newtons.

4. Two masses of 5.0 kg and 2.0 kg are in contact with each other on a smooth, frictionless surface. A force of 7.0 N acts on the 5.0 kg mass. Calculate the magnitude of the acceleration of the block-block system in meters per second squared.

	<p>Use the following situation below to answer questions 5-7.</p> <p>A 14 kg block rests on a horizontal table surface and is connected by a light cord passing over a frictionless pulley to a weight that hangs vertically. The coefficient of static and kinetic friction between the block and tabletop are 0.40 and 0.25, respectively.</p>  <p>The diagram illustrates a physics problem setup. A rectangular block labeled 'A' is placed on a flat, horizontal surface. A horizontal cord is attached to the left side of block 'A'. This cord passes over a circular pulley and hangs vertically down to a second rectangular block. The second block is shaded brown and has a textured surface, representing a hanging weight. The entire setup is positioned above a large, solid grey trapezoid representing a tabletop.</p> <p>5. What mass is required on the end of the cord to just move the 14 kg block (labeled as A above)? Round your answer to the nearest hundredth.</p> <p>6. Consider the situation above in (5). Now assume that the mass of the hanging block is 6.0 kg. What is the acceleration of the block after it begins to move? Round your answer to the nearest hundredth.</p> <p>7. Consider the situation above in (5). Again assume that the mass of the hanging block is 6.0 kg. What is the tension in the cord after the block begins to move? Round your answer to the nearest hundredth.</p>

	<p>Use the graph below to answer questions 8-11.</p> <p>velocity (m/s)</p>  <table border="1"><thead><tr><th>Time (sec)</th><th>Velocity (m/s)</th></tr></thead><tbody><tr><td>-5</td><td>10</td></tr><tr><td>10</td><td>60</td></tr><tr><td>15</td><td>60</td></tr><tr><td>30</td><td>0</td></tr><tr><td>40</td><td>-40</td></tr><tr><td>50</td><td>-10</td></tr></tbody></table> <p>8. Consider a racecar that moves according to the graph above. What is the position of the car at time $t = 20$ seconds?</p> <p>9. Consider a racecar that moves according to the graph above. What is the total distance traveled by the car from time $t = 0$ to $t = 30$ seconds in meters?</p> <p>10. Consider a racecar that moves according to the graph above. What is the average acceleration of the car from time $t = 20$ seconds to $t = 30$ seconds?</p> <p>11. Consider a racecar that moves according to the graph above. What is the average acceleration of the car over the entire period of motion?</p>	Time (sec)	Velocity (m/s)	-5	10	10	60	15	60	30	0	40	-40	50	-10
Time (sec)	Velocity (m/s)														
-5	10														
10	60														
15	60														
30	0														
40	-40														
50	-10														

	12. An object speeds up from 15 m/s to 35 m/s over 5 seconds. Assuming a constant acceleration, what is the acceleration of the object?
	13. Over what distance does the object above in (12) accelerate?
	14. A golfer strikes a golf ball on a level surface at an angle of 40° above the horizontal and gives the ball an initial velocity of 40 m/s. What is the horizontal range of the golf ball, assuming no air resistance? Round your answer to the nearest hundredth of a meter.
	15. An object has a mass of 1.5 kg and a speed of 5.0 m/s. What is the kinetic energy of the object?
	16. Which of the following objects has the highest quantity of kinetic energy? a) A 5 g marble moving at 50 m/s b) A 50 g golf ball moving at 25 m/s c) A 500 g basketball moving at 10 m/s d) A 5 kg bowling ball moving at 5 m/s
	17. A diver jumps off of a platform at a height of 10 meters. Assuming all of their potential energy is converted directly into kinetic energy, what is the velocity of the diver immediately before they contact the water?

	<p>18. A furnace advertises it has a heat energy rating of 100,000 BTU. If the furnace is rated at 95% efficiency, what is the expected energy output in Megajoules?</p>
	<p>Use the graph below to answer questions 19-21.</p> <p>19. An object is subject to a force according to the graph above. What is the impulse on the object caused by the force from $t = 0$ seconds to $t = 3.0$ seconds?</p>
	<p>20. An object is subject to a force according to the graph above. If an object begins with a momentum of 50 kg m/s, what is the final momentum of the object at $t = 5.0$ seconds?</p>
	<p>21. An object is subject to a force according to the graph above. If an object of mass 3.5 kg has a velocity of 2.5 m/s at time $t = 0$ seconds, what is the velocity of the object at time $t = 5.0$ seconds? Round your answer to the nearest hundredth of a meter per second.</p>

	22. The word "hovercraft" is a word and invention patented by whom?
	23. In what year was the word and invention "hovercraft" patented?
	24. Many commercial hovercrafts in England have historically been named the SR.NX, with X being a number (for example, the SR.N1 is known as the first modern hovercraft). What does the SR stand for?
	25. The SR.N6 was the final hovercraft in the SR.NX series. How many passengers could the SR.N6 handle?
	26. The Patrol Air Cushion Vehicle, or PACV, was used by the US Navy during what war/conflict?
	27. This PACV had what speed as a maximum (in miles per hour, rounded to the nearest whole mile per hour)?
	28. In what year was the SR.N1 first demonstrated to the public?

Team Name: KEY Team Number: KEY

Student Names: _____ & _____

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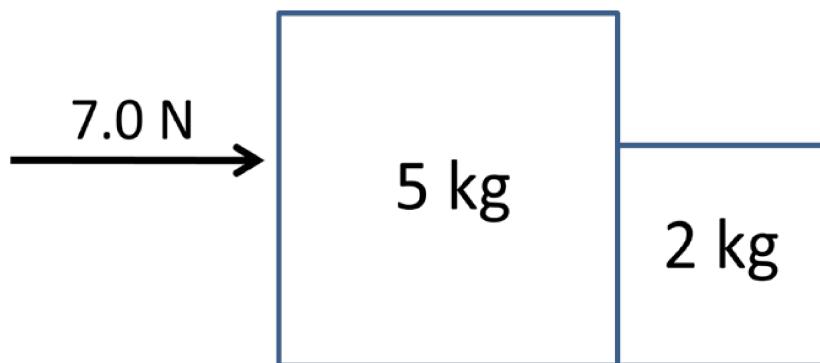
Questions 22-28: Air cushioned vehicles and applications: history, design, capabilities

Good Luck and Enjoy the Experience!

Second	1. Which of Newton's three laws states that the rate of change of momentum of a body is directly proportional to the force applied and this change in momentum takes place in the same direction as the direction of the applied force?
10 m/s²	2. What is the acceleration of an object of mass 15 kg that is pushed with a net force of 150 N?

2 N

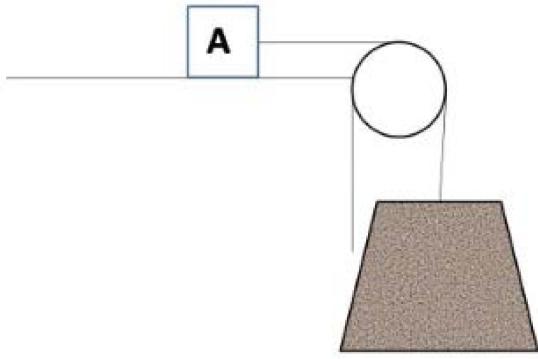
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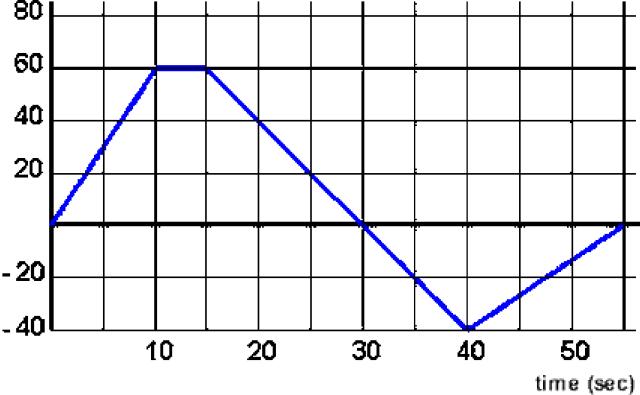


3. Two masses of 5.0 kg and 2.0 kg are in contact with each other on a smooth, frictionless surface. A force of 7.0 N acts on the 5.0 kg mass in the positive x-direction. Calculate the magnitude of the action-reaction force pair at the interface between the two masses in Newtons.

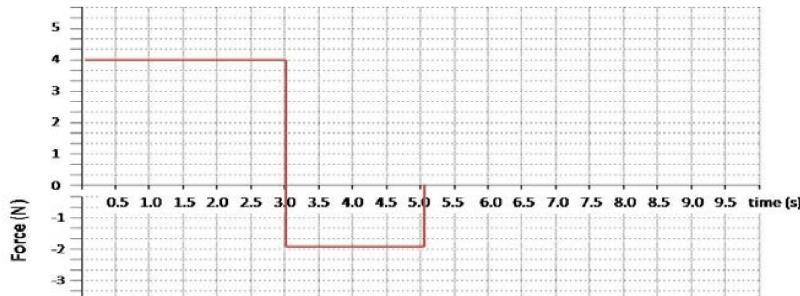
1 m/s²

4. Two masses of 5.0 kg and 2.0 kg are in contact with each other on a smooth, frictionless surface. A force of 7.0 N acts on the 5.0 kg mass. Calculate the magnitude of the acceleration of the block-block system in meters per second squared.

5.60 kg	<p>Use the following situation below to answer questions 5-7.</p> <p>A 14 kg block rests on a horizontal table surface and is connected by a light cord passing over a frictionless pulley to a weight that hangs vertically. The coefficient of static and kinetic friction between the block and tabletop are 0.40 and 0.25, respectively.</p>  <p>5. What mass is required on the end of the cord to just move the 14 kg block (labeled as A above)? Round your answer to the nearest hundredth.</p>
1.23 m/s²	<p>6. Consider the situation above in (5). Now assume that the mass of the hanging block is 6.0 kg. What is the acceleration of the block after it begins to move? Round your answer to the nearest hundredth.</p>
51.52 N	<p>7. Consider the situation above in (5). Again assume that the mass of the hanging block is 6.0 kg. What is the tension in the cord after the block begins to move? Round your answer to the nearest hundredth.</p>

850 m	<p>Use the graph below to answer questions 8-11.</p> <p>velocity (m/s)</p>  <table border="1"> <caption>Data points estimated from the velocity-time graph</caption> <thead> <tr> <th>Time (sec)</th> <th>Velocity (m/s)</th> </tr> </thead> <tbody> <tr><td>0</td><td>10</td></tr> <tr><td>10</td><td>58</td></tr> <tr><td>15</td><td>58</td></tr> <tr><td>30</td><td>0</td></tr> <tr><td>40</td><td>-40</td></tr> <tr><td>55</td><td>10</td></tr> </tbody> </table> <p>8. Consider a racecar that moves according to the graph above. What is the position of the car at time $t = 20$ seconds?</p>	Time (sec)	Velocity (m/s)	0	10	10	58	15	58	30	0	40	-40	55	10
Time (sec)	Velocity (m/s)														
0	10														
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-4 m/s²	<p>10. Consider a racecar that moves according to the graph above. What is the average acceleration of the car from time $t = 20$ seconds to $t = 30$ seconds?</p>														
0 m/s²	<p>11. Consider a racecar that moves according to the graph above. What is the average acceleration of the car over the entire period of motion?</p>														

4 m/s ²	12. An object speeds up from 15 m/s to 35 m/s over 5 seconds. Assuming a constant acceleration, what is the acceleration of the object?
125 m	13. Over what distance does the object above in (12) accelerate?
160.77 m	14. A golfer strikes a golf ball on a level surface at an angle of 40° above the horizontal and gives the ball an initial velocity of 40 m/s. What is the horizontal range of the golf ball, assuming no air resistance? Round your answer to the nearest hundredth of a meter.
18.75 J	15. An object has a mass of 1.5 kg and a speed of 5.0 m/s. What is the kinetic energy of the object?
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14 m/s	17. A diver jumps off of a platform at a height of 10 meters. Assuming all of their potential energy is converted directly into kinetic energy, what is the velocity of the diver immediately before they contact the water?

100.23 MJ	18. A furnace advertises it has a heat energy rating of 100,000 BTU. If the furnace is rated at 95% efficiency, what is the expected energy output in Megajoules?
12 kg m/s	Use the graph below to answer questions 19-21.  19. An object is subject to a force according to the graph above. What is the impulse on the object caused by the force from $t = 0$ seconds to $t = 3.0$ seconds?
58 kg m/s	20. An object is subject to a force according to the graph above. If an object begins with a momentum of 50 kg m/s, what is the final momentum of the object at $t = 5.0$ seconds?
4.79 m/s	21. An object is subject to a force according to the graph above. If an object of mass 3.5 kg has a velocity of 2.5 m/s at time $t = 0$ seconds, what is the velocity of the object at time $t = 5.0$ seconds? Round your answer to the nearest hundredth of a meter per second.